



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/645,871	08/22/2003	Hajime Ogawa	67471-024	8653
7590	05/19/2006		EXAMINER	
MCDERMOTT, WILL & EMERY 600 13th Street, N.W. Washington, DC 20005-3096			VO, TED T	
			ART UNIT	PAPER NUMBER
			2191	

DATE MAILED: 05/19/2006

Please find below and/or attached an Office communication concerning this application or proceeding..

Office Action Summary	Application No.	Applicant(s)
	10/645,871	OGAWA ET AL.
Examiner	Art Unit	
Ted T. Vo	2191	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 22 August 2003.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-11 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 8/27/03 is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
 Paper No(s)/Mail Date 8/22/03
- 4) Interview Summary (PTO-413)
 Paper No(s)/Mail Date. _____.
- 5) Notice of Informal Patent Application (PTO-152)
- 6) Other: _____.

DETAILED ACTION

1. This action is in response to the communication filed on 08/22/2003.

Claims 1-11 are pending in the application.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 6, 11 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 6 is indefinite because of improper multi-dependency. Interpretation for the claim limitation is converting a program into object program.

Claim 11 is indefinite because of improper multi-dependency. Interpretation for the claim limitation is storage for storing a program.

Claim Rejections - 35 USC § 101

4. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

5. The claims 1-11 are rejected under 35 U.S.C 101 because the claimed invention is directed to non-statutory subject matter.

A claimed invention as a whole must accomplish a practical application. That is, it must produce a "useful, concrete and tangible result." State Street, 149 F.3d at 1373, 47 USPQ2d at 1601-02.

As per Claim 1: Despite claiming "instruction scheduling method", Claim 1 recitation is solely based on two steps, "a priority calculation step" and an execution timing decision step". The scope of claim 1, as a whole, does not show what it produces, but a two functional portions of a program. A claim that meet 101 issue must clearly produce a "useful, concrete and tangible result", according to State Street, 149 F.3d at 1373, 47 USPQ2d at 1601-02. This claim fails to do so. It is merely to describe functional portions in a program. It is a program per se.

As per claims 2-3: Claims 2-3 further recite functional descriptive materials seen in programming, fail to remedy the deficiency in Claim 1.

As per claim 4: Claim 4 recitation is a determination on a judgment, the citation fail to produce a clear practical result, but manipulating a segment in a programming technique "if than else". The scope of claim 4 as a whole does, merely recites, "a decision judgment step of judging" and "a redcision step of retracting" based on a constraint "negative" setup in the programming technique. A claim that meet 101 issue must clearly produce a "useful, concrete and tangible result.", according to State Street, 149 F.3d at 1373, 47 USPQ2d at 1601-02. This claim fails to do so. It is merely to describe a functional portion of a program. It is a program per se.

As per claim 5: Claim 5 fail to remedy the deficiency in Claim 4.

As per Claim 6: The rejection of claim 6 under the issue 101 is provided with the same rationale addressed in Claims 1-4 above.

As per Claims 7-8: Despite reciting "device", the specification and the scope claims fail to limit what "device" is. The claims fail to meet to produce a "useful, concrete and tangible result.", according to State Street, 149 F.3d at 1373, 47 USPQ2d at 1601-02.

As per Claims 9-10: Regarding claims 9-10, the claims recite a computer program per se, "A computer-executable program". Despite using, "having a computer execute:", this phase is an intended use. The Claims, as defined by the preamble, are mere computer programs, and thus are claiming a computer program per se. The Claims are non-statutory.

As per Claim 11: Because Claim 11 is indefinite as noted above, and it is interpreted as a computer program stored in a readable medium; therefore, Claim 11 fails to produce a result. It requires a storage medium must produce a "useful, concrete and tangible result. This type of claim fails to do so.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

- (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
- (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claim 1-11 are rejected under 35 U.S.C. 102(b) as being anticipated by Palem Krishna, "Code Optimization in Modern Compiler", http://www.cs.nyu.edu/courses/spring00/G22.3130-001/krishna_slides.pdf, 1998 (hereinafter: Palem).

Given the broadest reasonable interpretation of followed claims in light of the specification.

As per Claim 1: Palem discloses,

An instruction scheduling method comprising:

a priority calculation step of calculating a priority of each of a plurality of instructions that are subjected to scheduling, See page 13, rank function for prioritizing nodes

With regard this limitation:

"based on dependencies between the plurality of instructions and constraints of hardware resources for processing the plurality of instructions, the dependencies being data dependency, anti-dependency, and output dependency;"

this limitation uses definition terms in according to the specification:

output dependency in which a resource defined by a predecessor is further defined by a successor. data dependency in which a resource defined by a preceding instruction (a predecessor) in an input program is referenced by a succeeding instruction (a successor) in the input program; anti-dependency in which a resource referenced by a predecessor is defined by a successor; and output dependency in which a resource defined by a predecessor is further defined by a successor.

It should be noted that, despite the terminological differences, these terms' definitions are conceptually used as variable constraints in a sequence of instructions brought to a phase of control flow analysis, (It would be defined and seen in Aho books in term of live variables or def-use/use-def chains, or such as $\text{out}[S] = \text{gen}[S] \cup (\text{in}[S] - \text{kill}[S])$ etc.), i.e., it obeys the dependent analysis rules where whoever reaches to this analysis he would or must apply. The above recitation falls in the the dependent analysis rules in the compilation. Therefore, Palest discloses this limitation as shown in the phase of Rank function associated with DAG in p. 13 and def/Use chaining for data dependence analysis in p. 7.

Furthermore, Palest discloses,

and an execution timing decision step of deciding an execution timing of an instruction having a highest priority., in phase of register allocation, this phase requires calculating executing timing as shown in p. 29.

As per Claim 2: Palest discloses,

The instruction scheduling method of claim 1, wherein the priority calculation step includes: a precedence constraint rank calculation substep of calculating a precedence constraint rank of each of the plurality of instructions, wherein (a) if the instruction has a succeeding instruction which is anti-dependent or output dependent on the instruction, the precedence constraint rank of the instruction is equal to a precedence constraint rank of the succeeding instruction, and (b) if the instruction has a succeeding instruction which is data dependent on the instruction, the precedence constraint rank of the instruction is higher than a precedence constraint rank of the succeeding instruction; and a resource constraint evaluation substep of judging (i) whether the instruction has a succeeding instruction which is dependent on the instruction, (ii) whether the instruction and the succeeding instruction have an equal precedence constraint rank, and (iii) whether a hardware resource for processing the instruction cannot process the instruction and the

succeeding instruction in parallel, and the priority calculation step raises the precedence constraint rank of the instruction and sets the raised precedence constraint rank as a priority of the instruction if all of the judgments (i), (ii), and (iii) are in the affirmative, and sets the precedence constraint rank of the instruction as the priority of the instruction if any of the judgments (i), (ii), and (iii) is in the negative.

See all Figures in p. 13 associated with analysis in p. 7.

As per Claim 3: Palest discloses,

The instruction scheduling method of claim 1, wherein the priority calculation step includes: a precedence constraint rank calculation substep of calculating a precedence constraint rank of each of the plurality of instructions, wherein (a) if the instruction has no succeeding instruction which is dependent on the instruction, the precedence constraint rank of the instruction is 1, (b) if the instruction has one or more succeeding instructions which are anti-dependent or output dependent on the instruction, the precedence constraint rank of the instruction is a highest one of precedence constraint ranks of the succeeding instructions, and (c) if the instruction has one or more succeeding instructions which are data dependent on the instruction, the precedence constraint rank of the instruction is a sum of 1 and a highest one of precedence constraint ranks of the succeeding instructions; and a resource constraint evaluation substep of calculating a resource constraint value of the instruction, by dividing a total number of instructions which are to be processed by a hardware resource for processing the instruction and whose execution timings have not been decided, by a maximum number of instructions that can be processed in parallel by the hardware resource, and the priority calculation step sets the resource constraint value as a priority of the instruction if the resource constraint value is larger than the precedence constraint rank, and sets the precedence constraint rank as the priority of the instruction if the resource constraint value is no larger than the precedence constraint rank.

See all Figures in p. 13 associated with analysis in p. 7.

As per Claim 4: Palest discloses,

An instruction scheduling method for sequentially deciding execution timings of instructions that are subjected to scheduling, comprising: a decision judgment step of judging, after an execution timing of a first instruction is decided (e.g. v2), whether an execution timing of a second instruction can be decided

so as to be within a predetermined time period (e.g. v3 or v4, In this case, v4 falls in a predetermined time period ('Functional unit'), based on a constraint of a hardware resource for processing the second instruction; and a redecision step of retracting, if the judgment is in the negative, the decision of the execution timing of the first instruction and deciding an execution timing of an instruction other than the first instruction (the instruction placed next to v2; in this case, is v4).

In light of the specification, the claim limitation falls in the performance of the Figures 169, 170, 171, 172, in p. 29, in combined with Fig 59, p. 10, where a sequence of instructions could be formed under a functional unit. The Figures show that after rank-performance (Figure 169), an instruction scheduling is judged based on constraints. It visually shows there are decisions causing the instruction scheduling to place v1, v2, v4, v3, v5, v6 in a sequence in accordance to Figure 172. It is clearly that the sequence is based on the execution timings of v1, v2, v3, v4, v5, v6, and the predetermined hardware resources (registers).

As per Claim 5: Palen discloses, *The instruction scheduling method of claim 4, wherein the predetermined time period is expressed by a number of clock cycles, the decision judgment step includes: a resource constraint evaluation substep of calculating a resource constraint value of the second instruction, by dividing a total number of instructions which are to be processed by the hardware resource and whose execution timings have not been decided, by a maximum number of instructions that can be processed in parallel by the hardware resource, and the decision judgment step judges in the negative if the resource constraint value is larger than the number of clock cycles (See Figures 169, 172).*

As per claim 6: With regards to, *A program conversion method characterized in that: an input program is converted to an object program including a plurality of instructions, and an execution timing of each of the plurality of instructions in the object program is decided using the instruction scheduling method of one of claims 1 to 5, refer to the rejection addressed claim 1.*

As per claim 7: With regards to, *An instruction scheduling device comprising: a priority calculation unit operable to calculate a priority of each of a plurality of instructions that are subjected to scheduling, based on dependencies between the plurality of instructions and constraints of hardware resources for*

processing the plurality of instructions, the dependencies being data dependency, anti-dependency, and output dependency; and an execution timing decision unit operable to decide an execution timing of an instruction having a highest priority., refer to the rationale addressed in the rejection of Claim 1 above.

As per claim 8: With regards to, *An instruction scheduling device for sequentially deciding execution timings of instructions that are subjected to scheduling, comprising: a decision judgment unit operable to judge, after an execution timing of a first instruction is decided, whether an execution timing of a second instruction can be decided so as to be within a predetermined time period, based on a constraint of a hardware resource for processing the second instruction; and a redcision unit operable to retract, if the judgment is in the negative, the decision of the execution timing of the first instruction and decide an execution timing of an instruction other than the first instruction., refer to the rationale addressed in the rejection of Claim 4 above.*

As per claim 9: With regards to, *A computer-executable program for instruction scheduling, having a computer execute: a priority calculation step of calculating a priority of each of a plurality of instructions that are subjected to scheduling, based on dependencies between the plurality of instructions and constraints of hardware resources for processing the plurality of instructions, the dependencies being data dependency, anti-dependency, and output dependency; and an execution timing decision step of deciding an execution timing of an instruction having a highest priority., refer to the rationale addressed in the rejection of Claim 1 above.*

As per claim 10: With regards to, *A computer-executable program for sequentially deciding execution timings of instructions that are subjected to scheduling, having a computer execute: a decision judgment step of judging, after an execution timing of a first instruction is decided, whether an execution timing of a second instruction can be decided so as to be within a predetermined time period, based on a constraint of a hardware resource for processing the second instruction; and a redcision step of retracting, if the judgment is in the negative, the decision of the execution timing of the first instruction and deciding an execution timing of an instruction other than the first instruction., refer to the rationale addressed in the rejection of Claim 4 above.*

As per claim 11: With regards to, *A computer-readable storage medium storing the program of one of claims 9 and 10.*, refer to the rationale addressed in the rejection of Claim 1 above.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ted T. Vo whose telephone number is (571) 272-3706. The examiner can normally be reached on 8:00AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wei Y. Zhen can be reached on (571) 272-3708.

The facsimile number for the organization where this application or proceeding is assigned is the Central Facsimile number **571-273-8300**.

Any inquiry of a general nature or relating to the status of this application should be directed to the TC 2100 Group receptionist: 571-272-2100. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Ted T. Vo
Primary Examiner
Art Unit 2191
May 12, 2006